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6 August 1980

Worldwide Report

ENVIRONMENTAL QUALITY

(FOUO 6/80)

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WORLDWIDE REPORT
ENVIRONMENTAL QUALITY

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CONTENTS

USSR

| | |
|--|----|
| Experts Discuss Drafts of Environment, Wildlife Laws (V. V. Petrov, et al.; SOVETSKOYE GOSUDARSTVO I PRAVO, May 80) | 1 |
| Automatic Air Pollution Monitoring (A. N. Shcherban', et al.; AVTOMATIZIROVANNYYE SISTEMY KONTROLYA ZAGRYAZNENNOSTI VOZDUKHA, 1979) | 12 |
| Conserving Water Resources (I. I. Borodavchenko, et al.; OKHRANA VODNYKH RESURSOV, 1979) | 14 |
| Spectroscopic Studies of Background Level of Gaseous Admixtures in the Atmosphere (V. I. Dianov-Klokov; VESTNIK AKADEMII NAUK SSSR, Apr 80) | 18 |

- a -

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USSR

EXPERTS DISCUSS DRAFTS OF ENVIRONMENT, WILDLIFE LAWS

Moscow SOVETSKOYE GOSUDARSTVO I PRAVO in Russian No 5, May 80 pp 88-93

[Article with statements by V.V. Petrov, S.A. Bogolyubov, M.M. Brinchuk, and L.A. Zaslavskaya: "Let Us Discuss the Drafts of Laws of the USSR on Protection of the Atmosphere and Protection and Utilization of the Animal World"]

[Text] The riches of nature in our country are a national treasure. The headlong rates of scientific and technical progress, the rapid development of industry, transport and agriculture are connected with the increasingly greater utilization of natural resources. All this increases responsibility for their wise exploitation, it generates higher demands regarding environmental protection.

In accordance with the USSR Constitution in the interests of the present and future generations in our country the necessary measures are being taken for protection of natural resources. In recent years a number of Principles of Legislation of the USSR and the Union republics has been adopted concerning protection of the land, minerals, waters and forests. The drafts of the Laws of the USSR on protection of the atmosphere and on protection and utilization of the animal world published for general discussion are evidence of the broad measures planned by the state for the purpose of protecting these natural targets and implementing control over their use. Statements by scholars regarding these drafts are published below.

V.V. Petrov, professor at Moscow State University, doctor of juridical sciences:

The Law of the USSR concerning protection of the atmosphere, just as the Law of the USSR on protection and utilization of the animal world, the drafts of which have been published for nationwide discussion, in essence

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continue the policy of unionwide codification legislative acts devoted to protection and utilization of individual types of natural targets. Being a component of the unified system of Soviet legislation about protection and rational utilization of the natural environment, these legislative acts, indisputably, bear the imprint of that standard model which was developed since the time of adoption of the Fundamentals of Land Legislation of the Union of Soviet Socialist Republics and the union republics and modified according to the degree of adoption of other codification acts regarding the waters, minerals and forests. Along with this they also possess a number of fundamental features, dictated by the specific nature of the ecological and economic functions performed by the given objects of nature.

1. In distinction to other objects of nature protected by law--the earth, minerals, and forests--the atmosphere does not possess, if it can be said this way, materially-embodied characteristics. By its properties it cannot be given or be turned into someone's property or possession. Practically this is expressed in that the draft of the law does not provide for the traditional norm on the right of ownership by the state of the corresponding object of nature, as has been done with respect to the land, minerals, waters and forests, which according to the Constitution of the USSR have been declared the exclusive property of the state.

In the Constitution of the USSR the animal world is not indicated in the list of natural objects comprising the exclusive property of the state, although in fact the state, in regulating the conduct of hunting and trapping, in establishing a procedure for turning over the pelts of a number of species of wild animals, and so on, has always acted as the autocratic subject of the right of ownership to the animal world in the limits of the country.

The draft of the Law of the USSR about protection and utilization of the animal world, in our view, adheres to the purely formal interpretation of article 11 of the USSR Constitution. Article 3 of the draft, allowing along with state ownership of the animal world the finding of objects of the animal world in the ownership of cooperative and other public organizations, thereby enters into contradiction with article 2 of the draft, where it is stressed that wild animals, maintained or raised in captivity or under semi-restricted conditions for economic, cultural, scientific and other purposes are not included as objects of protection and use on the part of the given law. In distinction to the state, which has established ownership of the animal world without any "physical" appropriation of it, by virtue of the fact of possession of the medium of its habitation, the cooperative and other public organizations which are not owners of the medium of habitation of the animals can become owners of objects of the animal world only as a result of appropriation of them by way of fishing, shooting, raising or maintaining animals in captivity or semi-restricted conditions. And such ownership is the possession, utilization, and disposal of commodity-material valuables with all the consequences ensuing therefrom.

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The absence in the draft law of the title of ownership to the atmosphere makes it possible to define the grounds according to which nature conservation activity is carried out in the USSR. All the nature protected by the law is not covered as objects of the right of ownership. Consequently legal protection of nature is not protection of the right of state ownership. It has a wider foundation, and namely: the interests of the present and future generations of Soviet people (article 18 of the Constitution of the USSR), expressing the ecological, economic, and spiritual needs of Soviet society, the material basis of which is socialist ownership of the means of production, including state ownership of objects of nature. The latter circumstance also pertains to the atmosphere. Certainly its protection depends to a considerable degree on regulation of the activity of sources of pollution of the air. The effectiveness of the control of such sources of pollution is directly dependent on the type of ownership of the means of production, prevalent in the society. Therefore in the preamble of the draft law it should be stressed that the Soviet government implements a group of measures for protection of the atmosphere on the basis of socialist ownership of the means of production.

2. In the process of codification of unionwide legislation on nature conservation and rational use of natural resources the unionwide legislative acts have been enriched with new regulations, not known to the first natural resource acts of codification. Among them are the norms of the Fundamentals of Forest Legislation, and the Fundamentals of Legislation on Minerals, which envisage the most important demands of protection of the corresponding natural object. Such demands, fixed in legal norms, perform the role of sectorial principles of protection of the natural object, called upon to insure unity of the conservation activity in the framework of a specific sector of legislation.

The draft of the Law of the USSR about protection and utilization of the animal world takes in this positive experience of nature-resource legislation. However in the draft of the Law of the USSR about protection of the atmosphere such regulations are absent, which waters down its content. Inherent to the atmosphere are the same directions of its protection as for other objects of nature, that is, protection against pollution, depletion, destruction. Taking into account the specifics of the given object of nature the basic demands of its protection could be formulated as follows: prevention and elimination of pollution of the atmosphere above tolerable norms; non-depleting utilization of the atmosphere and advancing reproduction of its oxygen resources; planning of measures for protection of the atmospheric basin and forecasting of its long-term changes taking economic activity into account; the compulsory nature of the norms of maximum tolerable harmful actions on the atmosphere; the conduct of ecological expert reviews of the plans for placement, construction and reconstruction of enterprises, facilities, technological lines, equipment, means of transport, and the use of chemical means in the national economy.

3. Reproduced in all Fundamentals of Legislation about protection of nature and rational utilization of natural resources is a unified scheme of responsibility for violation of legislation about protection and use of

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the corresponding object of nature. The draft of the Law of the USSR about protection of the atmosphere departs from this rule. In article 27 the responsibility is only proclaimed, but the content of infringements is not disclosed. Of course, the peculiarity of the object of nature considered does not make it possible to speak of such violations as buying and selling, barter, mortgaging, unauthorized seizure and use, which are connected with the regime of state ownership of natural objects. But practice points to other types of violations closely connected with protection of the air basin: pollution of the atmosphere or other action harmful to it by chemical, physical or biological factors; non-application or violation of established norms of maximum permissible harmful action on the atmosphere; violation of ecological demands of protection of the atmosphere during planning, designing, placement, and operation of industrial-economic projects; non-observance of the rules of operation of purification facilities and devices; nonfulfillment of plans and measures for protection of the atmosphere, and so on.

It is known that measures of responsibility achieve a result when they are combined with measures for material and moral incentives. Following the experience of preceding Fundamentals of Legislation about protection of nature and rational utilization of natural resources the draft of the Law of the USSR about protection of the atmosphere provides for norms of such a direction. However in article 21 of the draft it speaks about this only on the level of an incentive, while covered by the concept of "stimulation" are also negative measures connected with deprivation of bonuses, imposition of disciplinary penalties for nonfulfillment of plans and measures in the area of protection of nature and administrative penalties for violation of compulsory rules of protection of the atmosphere. Among the measures of material action the draft also names replacement of the damage caused by violation of the legislation on protection of the atmosphere. It is understood that such a measure is applied only in the presence of the guilt of the causer of the damage--the enterprise, organization or other owner of the source of pollution of the atmosphere.

In addition, article 12 provides a rule according to which due to the impossibility of fulfillment of the norms of maximum permissible harmful actions enterprises are transferred to another locality or the profile of their work is changed. It goes without saying that both the transfer of an enterprise and the change in the profile of its production require preparation and time, in the course of which the enterprise continues to pollute the environment, without bearing any kind of liability, including material liability, for this. Such a situation also occurs when an enterprise is converted to a regime of gradual introduction of ecologically safe technological processes or is being equipped with purification facilities.

When polluting the atmosphere and consuming the resources of nature, an enterprise at the same time is in an equal or even better position in comparison with those production facilities which according to the law bear material responsibility for the damage caused by pollution of the air

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basin. Such a procedure does not stimulate the enterprise in the cause of improving protection of the environment. Moreover, this allows it to consume natural resources, and the expenditures for improving the environment are shifted to other organizations.

In order to insure equal conditions of production activity of enterprises using the resources of the air, and for their equitable contribution to protection of the atmosphere it would be advisable for those enterprises which cause damage to the environment, not having direct guilt in the contamination, to introduce a system of an ecological tax equal to the cost of the expenses for improving the environment. Something like this has already been used in the field of protection of the waters, but it has not brought the desired results, for the reverse picture has been ascertained--enterprises, paying the imposed sum, actually have bought themselves off from the conduct of measures for protection of nature. And this has occurred because the funds for the fee were planned ahead of time by the ministry, and after they were exacted, they were depersonalized. The system of an ecological tax proposed by us should be organized on a fundamentally new basis. The fee for pollution is subject to being charged at the expense of the prime cost of output released. The funds received from payment of the tax are accumulated in a special account of the local soviets of people's deputies and are spent exclusively on measures for improving the environment of the given region. Such a procedure is reminiscent to some degree of the replacement of losses of agricultural production established by legislation for the purpose of insuring nondepletion of agricultural land utilization. In other words, losses of resources in one case should be compensated by outlays for its reproduction--in the other case.

S.A. Bogolyubov, docent of the Academy of Social Sciences under the CPSU Central Committee, candidate of juridical sciences:

Publication of the draft of the Law of the USSR about protection of the atmosphere and its adoption are justly regarded by public opinion as an important contribution to insuring keeping the atmosphere clean, preventing and reducing its pollution, and strengthening the laws in the area of protection of the atmosphere.

Just as in other basic legislative acts which regulate social relations in the field of use and protection of different types of natural resources, contained in the draft law is an article about participation of public organizations and citizens in management of affairs connected with protection of the atmosphere, and in implementing measures in the field of its protection (article 6). Provided by the draft is the right of USSR citizens to participate in the management of affairs connected with protection of the atmosphere. Here it is possible to use the experience of the compilation and action of the Water Codes of a number of union republics, where certain forms of such participation are defined: assistance to state agencies through direct participation in conduct of the necessary operations, making of

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proposals about improving the use and protection of natural resources, and reports about known violations of the rules of their use and protection. On the other hand, enumeration of these form is an example, and, apparently, does not exhaust all the possible directions of nature conservation activity by citizens. In the draft these regulations are more general, permitting also other types of participation by citizens in the solution of ecological problems. Corresponding to the right of citizens is the duty of state agencies to consider in every way the proposals from the citizens and public organizations when carrying out measures for protection of the atmosphere. The indicated regulation also meets constitutional demands and the basic direction of development of the political system of Soviet society--the further development of socialist democracy.

As is known, the proposals of normative-legal acts contain rules of conduct and are usually descriptive, determinant. In the draft such a form finds wide use: "enterprises... are transferred" (article 12), "locations of construction... are agreed on" (article 13), "transport... means... are not admitted for operation" (article 15), and others. In ordinary speech the nature of inducement for these and other such proposals would be expressed by the words "should," "are obliged." Since the legislative norms contain general requirements of a prohibitive, imperative, right-granting nature, the need to use these linking words does not arise. The more so that the competence of state agencies often assumes both their right and at the same time their duty to perform (or not perform) a certain action. For instance, "observation... is accomplished by the statewide service..." designates both the right and the obligation of the state service for observation and control to perform its functions in accordance with the legislation (article 23). "...Executive committees of local Soviets of workers' deputies upon receipt of the information... will give instructions about the transfer to a special operating regime or temporarily stop the operation..." (article 24) assumes not only the right but also the obligation of taking the necessary measures in the case of appearance of a threat to the health and life of the people. In connection with this the use of unequal forms of obligation in the instructions is not always valid, since they in general, as it seems, do not correspond to the intention of the law-maker. Thus, according to article 19 of the draft in the case of changes in the atmosphere which have a harmful effect on the health of people the use of the air, in large volumes for industrial needs "can be limited, stopped or prohibited." Here it is necessary, in our view, to use the words "should be," and not "can be." The uniformity of the statement, comprehensive use of the descriptive form in normative acts contributes to uniformity in the application of the act.

In accordance with the draft, local agencies of state authority and control, and specially empowered agencies are allocated vast powers both in the operations-management, and in the inspection-control, and jurisdictional area. Even now questions are arising concerning the creation of a legal mechanism for realization of these powers, concerning the training of cadres in the spirit of exactingness, intolerance toward any deviations from this law. Formation of the conditions for public condemnation of

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persons the actions of whom lead to pollution of the atmosphere, would be aided by legal regulation of certain questions of publicity and registration of the public opinion when planning measures for protection of the atmosphere, during location, planning, construction and putting into operation enterprises, facilities and other objects which influence the state of the atmosphere, during discussion of the layout and building of cities and other population centers, during organization of measures for prevention and reduction of industrial, household and other noises.

When introducing the Law of the USSR about protection of the atmosphere it is possible to use the work experience of party, soviet, and economic organizations of the city of Ust'-Kamenogorsk regarding prevention of environmental pollution: the creation of public commissions in the rayons, and at enterprises; the conduct of inspections regarding nature conservation and raising the level of sophistication of production; broad use of the press, radio and television; effective exploitation of means for purification of gases; strengthening of technological discipline. All this has made it possible to improve the atmosphere somewhat in the region of Ust'-Kamenogorsk.¹ Ecological-legal training, persistence and the principled nature of workers in party, soviet, economic and inspection agencies, suppression of manifestations of complacency, irresponsibility, or a parochial approach to protection of the atmosphere will contribute to realization of the norms of the law being prepared.

¹See: Resolution of the CPSU Central Committee, "On the work of party, soviet, and economic organizations of the city of Ust'-Kamenogorsk for preventing pollution of the environment," PARTIYNAYA ZHIZN', 1978, No 15, pp 3-5.

M.M. Brinchuk, scientific associate of the Institute of the State and Law, USSR Academy of Sciences, candidate of juridical sciences:

The draft of the Law of the USSR on protection of the atmosphere has interpreted a number of norms of existing legislation about protection of the atmosphere, but it also contains a number of fundamentally new regulations, responding to the contemporary and future demands of practical experience. The most important feature of the draft is the orientation to prevention and reduction of the level of pollution of the atmosphere, the prevention of harmful physical and biological actions on it. The draft provides for regulation of a change in the composition of the atmosphere, noise pollution, or other physical actions, for instance from electromagnetic rays and biological factors, and also regulation of actions on the weather and climate.

Active air legislation is directed at protection of the atmosphere only in the limits of population centers. Such an approach cannot satisfy modern requirements. Pollution of the atmosphere causes damage not just

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to the health of man. Agricultural lands, forests and other vegetation, and the animal world suffer, and pollution of bodies of water and the surface of the soil occurs. Therefore the action of the future law will be spread to the whole territory of the country.

Establishment of norms of the maximum permissible concentrations of contaminating substances in the atmosphere is attributed in the draft to the competence of the Union of Soviet Socialist Republics. The permissible level of pollution safe for the health of people and the environment should be established at the level of the Union. However at the present time the quality of the atmosphere in the union republics is different (meaning the largest cities). It depends mainly on the saturation of the territory by industrial enterprises, which are the basic sources of pollution of the atmosphere. Is it worth it for republics, which have relatively clean air, to worsen its quality and bring it to the maximum permissible? In view of this it is advisable to supplement article 4 of the draft with a statement that the union republics are granted the right to establish norms of the maximum permissible concentrations that are more strict than the union norms. In such a case the norms will in fact serve as an important means of regulating the quality of the air.

The necessity of a differentiated approach to establishment of the levels of permissible pollution of the atmosphere is also brought about by the difference in the sensitivity of the biogeocenoses of different natural zones to one and the same contaminants of the air. In the first place this pertains to the northern regions, the biogeocenoses of which are distinguished by much greater sensitivity in comparison with the middle zone. Under conditions of intensive development of northern regions such an approach will contribute to lowering the possible unfavorable consequences for the environment as a result of pollution of the air. Other factors also exist which speak in favor of establishment of stricter indicators of permissible air pollution. A study in recent years of the topographic and hydromeliorative conditions of individual regions of the USSR has made it possible to single out the regions subject in a different way to the possibilities of pollution. Among the regions which have comparatively unfavorable meteorological conditions for scattering of impurities in the atmosphere, especially in the winter (presence of weak temperature inversions, light winds) are the Urals, Eastern Siberia, Central Asia. Observed in a number of cities and industrial centers of the USSR is the pollution of the air by dust, sulfur dioxide, carbon monoxide, and phenols.

Planning plays an important part in organization and implementation of air protection measures. A study of the practice of nature conservation activity shows that adopted plans are often not fully implemented. The basic cause of this is the shortage of manpower and physical resources. There have been cases when capital investments set aside for environmental protection have not been used in the way there were designated. In order to prevent such a practice and insure accounting of all factors during

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planning, it is advisable to supplement article 7 of the draft, devoted to planning measures for protection of the atmosphere, with a statement about setting aside the necessary physical, financial and manpower resources for the conduct of air protection measures. The physical and financial resources provided by the plan should have a strict target designation.

It appears advisable to change the title of section III of the draft, the title and text of article 22, where it speaks of state registration of objects having an unfavorable effect on the state of the atmosphere, and the proportions of this effect. Since the effect of objects on the state of the atmosphere cannot be favorable, the term "unfavorable effect" should be replaced by the term "harmful effect."

The agencies for monitoring the protection of the atmosphere have accumulated extensive work experience. The new Law of the USSR increases still more their potential and, on the other hand, with the adoption of the law the circle of their duties will be broadened. Under these conditions the activity of inspection agencies for protection of the atmosphere will depend to a definite degree on their technical equipment level, particularly on the provision of measuring apparatus for monitoring harmful substances in the discharges of stationary sources of pollution and in the exhaust gases of automobile engines, and on the provision of means of transport.

L.A. Zaslavskaya, senior scientific associate of the All-Union Scientific Research Institute of Soviet Legislation, candidate of juridical sciences, honored jurist of the USSR:

The Draft of the Law of the USSR about protection and utilization of the animal world has great national economic and nature conservation significance. Concise legal regulation of the protection and utilization of the animal world is necessary for insuring legality in the indicated area of social relations. In our opinion, the sphere of action of the law is correctly limited to relations regarding the protection and use of the animal world, residing in a state of natural freedom. Not falling under its action are relations connected with the protection and utilization of agricultural and other domestic animals, and also wild animals maintained and raised in captivity or semi-restricted conditions for economic, cultural, scientific and other purposes, since their protection has essential differences. Whereas wild animals are protected against shooting, and the medium of their habitation and routes of migration are also protected, the domestic animals, and also wild animals kept or raised in captivity can be protected only against cruel treatment of them and diseases. The draft law covers the basic group of questions of protection and utilization of the animal world. Along with this it needs certain supplements.

The animal world on the whole is among the reproducible natural objects. The state and organizations to which hunting lands are assigned, systematically expend means and labor for reproduction of the animal world.

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Therefore in article 1 of the draft, devoted to the goals of Soviet legislation about protection and utilization of the animal world, it is necessary to speak about reproduction of animals. There are norms concerning the reproduction of animals in many articles in the draft (articles 11, 12, 20, 25 and others). It would be advisable to unify them in a special section.

The articles about the basic types of utilization of the animal world, hunting (article 11) and fishing (article 12), need to be supplemented. These articles have been formulated very laconically. Whole sections can be given according to the significance and content of the legal material regarding the indicated types of use. In particular, it should have been pointed out in article 11, "Hunting," who has the right to hunt. In our opinion, it is possible to record that the right to hunt with firearms is enjoyed by all citizens of the USSR who have reached the age of 18, are members of a society of hunters, who have passed the tests for the shooting minimum and have paid the state tax. The right to hunt without firearms is enjoyed by all citizens independent of age or membership in a society of hunters. The list of animals, hunting for which is authorized to all citizens without firearms, is established by legislation of the union republics. Determination of the conditions for enjoying the right to hunt in regions of commercial hunting and by hunters from among the indigenous population of nationalities of the North can be assigned to the competence of the union republics. It is necessary to indicate in the law the basic documents on the right of hunting (hunter's member's ticket, hunter's ticket, license, permission of the administration of the hunting farm on the territory of which the hunting is being done). It is desirable to determine the procedure for assigning hunting lands to enterprises, institutions and organizations, and to include special norms about the running of a hunting farm and establishing hunting periods.

According to existing legislation, prohibited are hunting for polar bears,¹ and state trapping of walrus in the northern and far eastern waters, on islands and the coast of the Arctic Ocean and the Bering Sea in the limits of the RSFSR.² Therefore it should be written in the law that hunting for individual types of wild beasts and birds can be completely prohibited or limited by legislation of the Union of Soviet Socialist Republics and the union republics.

¹See: SP SSSR [Collection of Government Regulations and Decrees of the USSR], 1976, No. 1, article 2.

²See: "Sistematicheskoye sobraniye zakonov RSFSR, ukazov Prezidiuma Verkhovnogo Soveta RSFSR i resheniy Pravitel'stva RSFSR" [Systematic Collection of Laws of the RSFSR, Ukases of the Presidium of the RSFSR Supreme Soviet, and Decisions of the Government of the RSFSR], Vol VIII, Moscow, 1968, p 407.

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In article 12, devoted to fishing, it is advisable to provide the procedure and conditions of granting commercial fishing sectors for extraction of fish and other types of animals in fishery bodies of water, and to indicate the basic documents for the fishing right, and the procedure for performing sport and amateur catching of fish.

It is desirable to give in article 37 of the draft a concrete list of violations of legislation about protection and utilization of the animal world. In particular, it is possible to include here: illegal engagement in fishing and other water extracting enterprises, production of timber floating or explosive operations with violation of the rules for protection of fishing reserves, and illegal trapping. Apparently, it is necessary to provide that legislation of the Union of Soviet Socialist Republics and the union republics can establish responsibility also for other violations of legislation about protection and utilization of the animal world. In addition, the number of reference norms should be reduced by concretization of the draft law.

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AUTOMATIC AIR POLLUTION MONITORING

Kiev AVTOMATIZIROVANNYYE SISTEMY KONTROLYA ZAGRYAZNENNOSTI VOZDUKHA
[AUTOMATIC AIR POLLUTION MONITORING SYSTEMS] in Russian 1979 pp 2, 158

[Annotation and table of contents from book by A. N. Shcherban',
A. V. Primak and V. I. Kopeykin, Tekhnika Press, 5,000 copies, 158 pages]

[Text] The book deals with problems of environmental protection and in particular with the protection of atmospheric air against pollution, and it also elucidates present-day techniques and equipment for the automatic monitoring and measurement of pollutant concentrations in the air over cities and industrial centers.

The design principles, qualitative characteristics, and operating features of the first Soviet-made automatic air pollution monitoring systems are investigated in detail and elaborated. Solutions and developmental prospects of automatic control of atmospheric quality are considered.

The book is designed for engineers and technicians.

| Contents | Page |
|---|------|
| Introduction | 3 |
| Techniques and Equipment for Atmospheric Dust and Gas Analysis | 11 |
| Specific Features and Developmental Trends of the Design of Gas Analyzers for Monitoring Atmospheric Pollution | 11 |
| Methods for Automatic Monitoring of Toxic Ingredients of the Atmosphere | 19 |
| Instrumentation for Dust-and-Gas Monitoring of Air Pollution | 28 |
| Principles of Design and Tasks of Automatic Air Pollution Monitoring Systems | 40 |
| Design and Functioning Tasks and Technical Requirements for ASKZV [Automatic Air Pollution Monitoring Systems] | 40 |
| Structural Design of Components and of the System as a Whole | 45 |
| Analysis of Foreign ASKZV | 53 |

FOR OFFICIAL USE ONLY

FOR OFFICIAL USE ONLY

| | Page |
|---|------|
| Techniques of Designing ASKZV Along Commutable Communication Channels | 65 |
| Techniques for Designing ASKZV on the Basis of Isolated Communication Channels | 72 |
| Qualitative Characteristics of the Functioning of ASKZV | 75 |
| Estimation of the Information Content of ASKZV | 75 |
| The ASKZV as a Queuing System | 78 |
| Noiseproof Feature of ASKZV | 80 |
| Analysis of Communication Channels | 80 |
| Experimental Research Into the Reliability of the Transmission of Discrete Information at Low Speeds Along GTS Lines | 84 |
| Analysis of Noiseproof Feature of the System in Relation to Various Decoding Algorithms | 97 |
| Investigation of the Actual Capacity and Reliability of Data Transmission Systems With Waiting in the Asynchronous Operating Mode | 103 |
| Development of ASKZV Equipment | 117 |
| ASKZV Based on Commutable Communication Channels | 117 |
| ASKZV Based on Isolated Communication Channels | 132 |
| Forecasting as the Next Stage in Improving the Organizational Structure of ASKZV | 143 |
| Industrial Utilization of R&D Work on ASKZV | 149 |
| Bibliography | 153 |

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USSR

CONSERVING WATER RESOURCES

Moscow OKHRANA VODNYKH RESURSOV (Water Resources Conservation) in Russian 1979 pp 3, 245-247

[Annotation and table of contents from book by I. I. Borodavchenko, the late N. V. Zarubayev, Yu. S. Vasil'yev, Kh. A. Vel'ner and S. V. Yakovlev, Kolos Press, Moscow, 247 pages]

[Text] The monograph deals with aspects of the most rational utilization of water and land resources in the interests of developing agriculture, water management, and other branches of the economy. It presents data on the effect of anthropogenic activity on the quality of natural waters and the consequences of hydrotechnical and land-reclamation construction, and it describes measures to prevent the depletion and contamination of water resources.

This book is designed for scientific workers at research and design institutes of land reclamation and water management.

| Contents | Page |
|--|------|
| FOREWORD | 5 |
| WATER RESOURCES OF THE USSR | 7 |
| Distribution of Natural Waters Over the Nation's Area | 7 |
| State of Knowledge of Water Resources | 11 |
| Systems and Procedures for Keeping Track of the Utilization of Water Resources | 13 |
| Classification of Water Management Systems and Problems of Their Modeling | 14 |
| Hydrological Forecasting and Its Role in the Economy | 18 |
| Changes in River Runoff Owing to Anthropogenic Activity | 20 |
| PRINCIPLES OF WATER UTILIZATION | 24 |
| Classification of Water Uses | 24 |
| Water Supply of Inhabited Areas | 26 |

FOR OFFICIAL USE ONLY

FOR OFFICIAL USE ONLY

| | Page |
|--|---------|
| Land Reclamation | 27 |
| Industrial Water Supply | 32 |
| Water Transport | 34 |
| Fisheries | 35 |
| Water Sports | 37 |
| Rivers and Open-Water Bodies as Recipients of Liquid Wastes | 38 |
| Forecasts of Water Utilization in the Economy | 39 |
| EFFECT OF ANTHROPOGENIC ACTIVITY ON THE QUALITY OF WATER RESOURCES | 43 |
| Principal Sources of Water Contamination | 43 |
| Methods for Estimating Water Quality in Water Facilities | 44 |
| Methods for Analysis of Natural Waters and Liquid Wastes | 49 |
| Background Waters and Their Qualitative Indicators | 51 |
| Contamination of Rivers and Open-Water Bodies | 54 |
| Processes of the Conversion of Contaminants in Rivers and Open-Water Bodies | 61 |
| Effect of Hydrological and Meteorological Factors on the Quality of Water in Watercourses and Open-Water Bodies | 69 |
| MEASURES TO PREVENT DEPLETION AND CONTAMINATION OF NATURAL WATERS AND IMPROVE THEIR QUALITY | 73 |
| Principal Methods for Improving Water Quality | 76 |
| Principal Water Treatment Processes | 78 |
| Methods and Facilities for the Demineralization of Water | 81 |
| Experience in Operating Small Water Treatment Plants in Rural Areas | 82 |
| New Process Flowcharts for Comprehensive Purification of Industrial Wastes in Rural Areas | 85 |
| Utilization of Liquid Waste Precipitates | 90 |
| Basic Premises for an Ecologically Oriented Agricultural Production | 94 |
| PURIFICATION OF LIQUID WASTES | 100 |
| Classification of Liquid Waste Purification Techniques | 100 |
| Conditions for Discharging Liquid Wastes Into Open-Water Bodies | 103 |
| Design of Liquid Waste Treatment Stations | 104 |
| Facilities for Mechanical, Physico-Chemical and Biochemical Treatment of Liquid Wastes | 107 |
| Methods for Treatment of Liquid Waste Residues | 118 |
| Disinfection of Liquid Wastes | 126 |
| Liquid Waste Treatment on Large Animal Husbandry Farms | 127 |
| Pumping Liquid Wastes Into Underground Strata | 129 |
| Experience in Operating Small Sewage Treatment Plants in Rural Areas | 130 |

FOR OFFICIAL USE ONLY

| | Page |
|---|------|
| AGRICULTURAL UTILIZATION OF LIQUID WASTES | 135 |
| Types of Liquid Wastes Used for Irrigation | 136 |
| Treatment of Liquid Wastes for Irrigation | 142 |
| Design of Irrigation Systems | 145 |
| Moisturizing Conditions and Facilities for ZPO Irrigation | 150 |
| Effect of Irrigation With Liquid Wastes on the Environment | 155 |
| Utilization of Warm Waters in Agriculture | 158 |
| Utilization of Warm Waters in Fishery | 161 |
| WATER-MANAGEMENT MEASURES AND THEIR ENVIRONMENTAL EFFECTS | 164 |
| General Assessment of the Consequences of Hydrotechnical Construction | 164 |
| Effect of Impounding Reservoirs on Natural Conditions | 166 |
| Changes in Natural Conditions Along Water Transit Routes | 173 |
| Effect of Irrigation on Natural Conditions | 175 |
| Consequences of Drainage Measures | 177 |
| Long-term Forecasting of the Utilization of Water Resources With Allowance for Natural Conservation | 179 |
| PLANNING THE UTILIZATION AND CONSERVATION OF WATER RESOURCES | 182 |
| Development of Systems for Comprehensive Utilization and Conservation of Water Resources | 182 |
| Principles of Cadastral Water-Management Surveying | 184 |
| Techniques for Compiling Balance Sheets of Water Management With Allowance for Water Quality | 189 |
| Determination of River Discharge Limits | 195 |
| Methods of Computing the Quality of Natural Waters | 201 |
| NATURAL WATER QUALITY CONTROL SYSTEMS | 207 |
| Existing Structure of Water Quality Control in the USSR | 207 |
| Autonomous Water Quality Control Systems | 208 |
| Statistical Processing of Data on Water Quality Parameters | 212 |
| Aircraft and Outer-Space Methods for Observing Natural Resources | 216 |
| ECONOMIC SUBSTANTIATION OF WATER CONSERVATION MEASURES | 218 |
| Evaluation of Water Conservation Measures | 218 |
| Comparative Economic Effectiveness of Variants of Water Conservation Measures | 220 |
| Financial Estimate of the Utilization and Conservation of Water Resources | 223 |
| Effectiveness of Natural-Conservation Measures to the Development of Large Water-Management Systems | 227 |

FOR OFFICIAL USE ONLY

| | PAGE |
|--|------|
| INTERNATIONAL COOPERATION IN CONSERVING WATER RESOURCES | 229 |
| Management of Rational Utilization and Conservation of Waters in the USSR | 229 |
| Monitoring of the Utilization and Conservation of Water Resources in Various Countries | 232 |
| Joint Activities of CEMA Member Countries in Combating the Contamination and Depletion of Water Resources | 235 |
| Experience in Cooperation Between the USSR and the Capitalist Countries | 236 |
| BIBLIOGRAPHICAL INDEX | 239 |

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SPECTROSCOPIC STUDIES OF BACKGROUND LEVEL OF GASEOUS ADMIXTURES
IN THE ATMOSPHERE

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 4, Apr 80, pp 33-41

[Article by Doctor of Physico-Mathematical Sciences V.I. Dianov-Klokov]

[Text] The importance of studies of low levels of gaseous admixtures in the atmosphere which pollute the air on a planetary scale has now become obvious. The rates of growth of technogenic emissions of carbon monoxide, nitrous oxides, sulfur compounds, freons and other gases into the atmosphere are increasing precipitously. Thus, in the 1970's, carbon monoxide emissions reached 700 million tons per year (the equilibrium level of this toxic admixture in the entire earth's atmosphere constitutes 600 million tons). We can consider that, if these rates of emission continue, twice as much carbon monoxide as its present equilibrium level will enter the earth's atmosphere in 2000 A.D.

Thus, there is a real threat of a worsening of the gaseous composition of the atmosphere of the entire world as a result of man's activity. Objective signs of global processes of this kind may be indicated by data concerning the increase of the level of contaminating components in the air over the "purest" spots on the planet, remote from industrial centers, that is, the increase of the background level of gaseous admixtures over these areas.

Now there are highly developed local methods for determining atmospheric pollution, which methods are directed, basically, to the study of the purity of the surface atmosphere over individual regions of towns, over industrial enterprises, etc.. The use of these methods for evaluating trends of change of atmospheric composition on a global scale is not always possible since, in spite of the high accuracy of single measurements, any kind of local sources of pollution may affect them. Therefore, in order to obtain data concerning changes of the atmospheric composition on a global scale, averages of measurements of air characteristics for a large area are promising. Integral methods are more economical in observations of large regions and are affected less by small-scale irregularities of

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the air composition than is the case for methods of local analysis. One of the possible variants of the integral procedure is the determination of the total content of gaseous admixture in the entire atmospheric layer, that is, the use of absorption spectroscopy with the sun as a source of radiation (Figure 1).

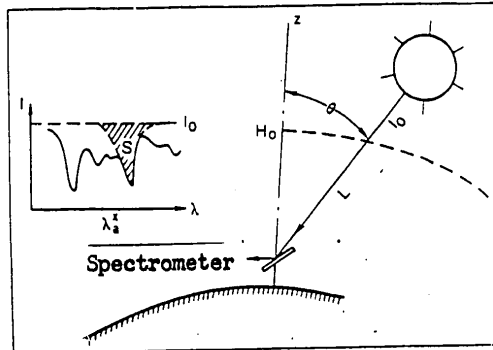


Figure 1. Diagram of spectroscopic determination of the integral level of an admixture in the atmosphere by the sun. z - height, θ - zenith angle of the sun, $L \approx H_0 \sec \theta$ is the length of the path of the beam in the troposphere, $H_0 \approx 8$ km is the height of the reduced atmosphere λ_a^x , S is the length of the wave and the integral absorption of an analytic line in the spectrum of the component of x determined, I_0 , I are intensities of radiation incident into and passing through the atmosphere.

If you disregard difficulties associated with heterogeneity of the atmosphere, the idea of the spectroscopic method is extremely simple. Solar radiation, passing through the air mass falls upon the spectrometer which registers the absorption spectrum. In the spectrum are isolated lines or bands, relating to the component measured and the quantity of the absorbent in the atmosphere is determined by the characteristics of these bands. If you measure the Solar radiation at different heights over the horizon, then in an extreme case of observation from the earth's surface, the rising or setting sun of the transmitted ray in the troposphere might reach lengths of hundreds of kilometers. This magnitude is near to that of a percent of the circumference of the earth, that is, the average for the space may be significant.

Practical realization of the integral spectroscopic method is complicated by the fact that, with heterogeneous distribution of the admixtures being analyzed according to the height of the atmosphere, the connection between the intensity of absorption lines and bands in the spectrum and the quantity of absorbing gas in the air mass differs. In this case, determination of the gas level according to spectroscopic data is, in the mathematical sense, an improper inverse problem, for solution of which is required

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a priori information concerning the profile of the concentration of the admixture sought. In most cases, such information is obtained and solution of the problem is possible.

We also emphasize that apparatus with sufficiently high spectral resolution is required to obtain acceptable accuracy of measurement of the gas level. There have been developed, at the USSR Academy of Sciences Institute of Physics of the Atmosphere (IPA) transportable spectrometric laboratories of such a type, with the help of which, measurements were conducted in different regions of the Soviet Union and aboard scientific research ships in the Antarctic.

As was already mentioned, it is necessary to select points sufficiently distant from intense pollution sources during determination of the background level of an admixture. Quantitative estimation of criteria of remoteness require, first of all, a study of the thickness and extent of caps of anthropogenic admixtures over towns by the integral method.

Regular spectroscopic measurements showed that the average magnitude (for several years) of carbon monoxide level over Moscow exceeds the analogous magnitude over Zvenigorod (Zvenigorod Scientific Station of IPA) by 60-70 percent (Figure 2). On days when ventilation is difficult (inversions, calm) this amount might increase 3-4 times. Since the anthropogenic municipal "increment" of carbon monoxide is concentrated in a rather narrow layer (nearly 100-500 m), its surface concentration may be, in such situations, greater than the natural background level by 100-200 times, that is, it may exceed the maximum permissible concentration significantly.

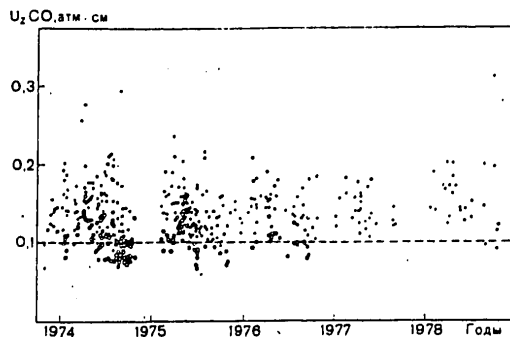


Figure 2. Average daily values of carbon monoxide level over Moscow and over Zvenigorod Scientific Station. • - over Moscow, o - over Zvenigorod Scientific Station, dotted line is the mean background level of carbon dioxide, U_z is the reduced thickness of the layer of pure carbon monoxide (in centimeters) at the surface of the earth at a pressure of one atmosphere.

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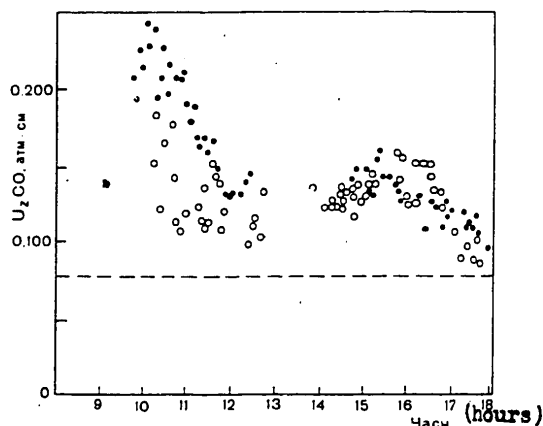


Figure 3. Daily changes of carbon monoxide level over Yerevan in comparison with its mean value over Sevan (correction for the difference of altitudes of plotting)
 • - measurements of 7 October 1977, o - measurements of 3 October 1977, dotted line -- mean background level of carbon monoxide over Sevan.

The integral spectroscopic method was used also in studies of atmospheric pollution by carbon monoxide over other towns, including Novosibirsk, Yerevan, Dnepropetrovsk and Sofia. It is important to note that this method provides data which characterize the air basin regime over the city as a whole (Figure 3) and not just the regime of some individual enterprise or transportation center.

As the studies showed, it is possible, for approximate evaluations, to assume that the time-averaged contribution of the man-made addition of a conservative admixture in its integral content into the atmosphere decreases approximately as the square of its distance from the town. Thus, if the anthropogenic addition equals the background level then, within the limits of accuracy of measurement of the integral level of the admixture of nearly 10 percent, the effect of the town is not observed at distances of more than 3-4 of its radii. Consequently, data of measurements which were conducted at Zvenigorod Scientific Station of IFA, which is 60 km from Moscow, may, with sufficient accuracy, be counted as background. In case large towns are close to one another, with the distance between them less than 6-8 radii of the town, individual anthropogenic caps will be connected and measurements of the background concentration of the admixture in such regions will appear to be practically impossible. The trend toward the expansion of industrial centers and the clustering of them on the European continent makes, therefore, the development of a network of

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observation points in the Asiatic USSR and also in the Arctic and Antarctic especially promising.

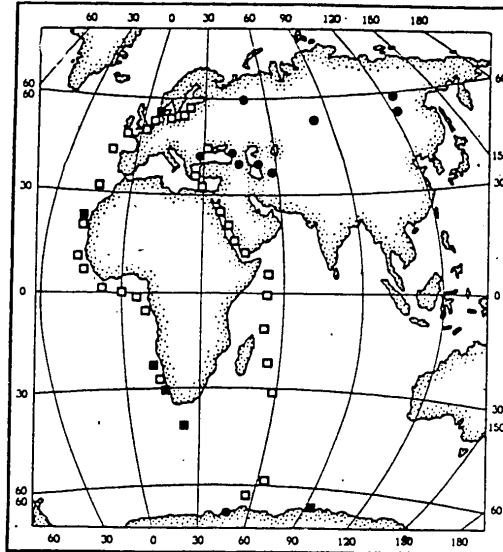


Figure 4. Spectroscopic measurements on dry land (●) and over the ocean (□, ■)

Points on dry land (Figure 4) were selected with consideration of the reasons given. Measurements in the USSR, in addition to those performed at Zvenigorod, were conducted in the summer months in the Northern Caucasus, in Krasnodar Kray, Komi ASSR, Central Asia, Novosibirsk and Amur oblasts and Yakut. Observations are being performed in collaboration with the Bulgarian Academy of Sciences in Bulgaria at Cape Kaliakra. Measurements over dry land produced data concerning the background level of some gaseous admixtures over a considerable part of the Eurasian continent and also over the Antarctic Continent ("Molodezhnaya" Station) during the seasonal operations of the 23rd Soviet Antarctic Expedition.

We shall now discuss some results of study of the background level of small gaseous admixtures over the USSR as a whole. Expeditionary measurements performed by the Institute of Physics of the Atmosphere showed that the background level of carbon monoxide is practically uniform over the entire USSR (Table) and constitutes nearly $0.1 \text{ atm} \cdot \text{cm}$ (thickness of the layer of pure carbon monoxide at the surface of the earth at 1 atm.). The confirmation, during this, of the possibility of use of Zvenigorod scientific station as one of the reference points for background observations was extremely important.

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The table indicates that the average monthly value of the total carbon monoxide content in the atmosphere over Zvenigorod Scientific Station and those over known unpolluted regions practically coincide.

One of the most important results obtained from processing the measurements data was the revelation of the seasonal course of the carbon monoxide background level and the trend of its secular variation.

Results of studies at Zvenigorod Scientific Station in 1970-1976 (See Figure 5)¹ show that, at present, there is occurring, in the northern hemisphere, a pronounced growth of mean-monthly values of background level of carbon monoxide in the cold period of the year and a reduction of it to a certain minimum in the warm period. Comparison with data from J. Shaw for Columbus indicates that this minimum, within the limits of error of measurements, has not changed for the last 20-25 years and, consequently, may be assumed to be stationary. It is significant that Shaw's data show a slightly pronounced accumulation of carbon monoxide in the winter and the spring in comparison with data obtained at Zvenigorod Scientific Station in the 1970's. This agrees with the growth (approximately doubled for the 25 years) of the thickness of technogenic sources of carbon monoxide. The illustration shows seasonal changes of the annual accumulation of technogenic carbon monoxide in the atmosphere. The slopes of the corresponding straight lines agree with the growth rates in the years indicated (1952-1971) of the level of this admixture in the atmosphere in the cold seasons.

The correctness of the observed picture of the seasonal course can be confirmed by the data of local chemical determinations by V. Zaylor of the carbon monoxide concentration in the surface layer of air over Mauna-Loa Island presented in Figure 5. The overall level of carbon monoxide, calculated on the basis of these data, varies in dependence on the season precisely the same way as do those measured at Zvenigorod Scientific Station. We emphasize that the lower absolute levels of carbon monoxide over Mauna-Loa in comparison with Zvenigorod Scientific Station corresponds quantitatively to trends of reduction of the carbon monoxide level in the earth's atmosphere from north to south.

¹. In Figure 5, as in Figures 6 and 7 later, the ratio between U_z and \bar{r} satisfies $U_z \text{ (atm} \cdot \text{cm)} = H_0 \bar{r}$ (parts per million) where the height of the atmosphere cited is $H_0 = 8 \text{ km}$.

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Average Monthly Values of Total Carbon Monoxide Level Over the USSR atm • cm

| Observation Point | April | May | June | July |
|---------------------------------------|-------|-------|-------|-------|
| Zvenigorod Scientific Station | | | | |
| 1973 | 0.110 | 0.108 | 0.091 | 0.094 |
| 1974 | 0.139 | 0.111 | 0.097 | 0.091 |
| 1975 | 0.123 | 0.120 | 0.074 | 0.082 |
| Cheleken (Central Asia) 1973 | 0.095 | - | - | - |
| Kislovodsk, 1973 | - | - | 0.092 | - |
| Ashkhabad, 1974 | 0.098 | - | - | - |
| Borovoye (Novosibirsk Oblast), 1974 | - | 0.104 | 0.100 | 0.088 |
| Aldan (Yakut ASSR), 1975 | - | - | 0.092 | 0.082 |
| Skovorodino, Amur Oblast, 1975 | - | - | - | 0.080 |
| Mean average level of carbon monoxide | 0.113 | 0.111 | 0.091 | 0.086 |

The existence of a stationary summer minimum of carbon monoxide level noted by us deserves attention. It suggests the presence of a natural, powerful mechanism of regulation of the carbon monoxide level in the atmosphere, which mechanism has the capacity to neutralize the continuously increasing effect of air pollution by technogenic carbon monoxide in the warm period. Such a conclusion is confirmed by the fact that outbursts of the background level of carbon monoxide over the European USSR in the anomalous (for synoptic conditions) year of 1972, disappeared the following year.

One of the possible elements of this mechanism of regulation may be the consumption of carbon monoxide by soil bacteria, becoming activated within a certain range of positive temperatures and reproducing practically unlimitedly under favorable conditions. Proceeding from the assumption concerning the decisive role of the bacteria drain of carbon monoxide and the preservation of the rates of growth of its technogenic emissions, it is possible to predict the background level of this gas in the year 2000. An accumulation of carbon monoxide will be observed only in winter, in summer, during unlimited growth of the mass of soil bacteria, the carbon monoxide level remains unchanged (See Figure 5).

The integral spectroscopic method was used also for the study of seasonal changes of methane level in the entire atmospheric stratum over different points of the European USSR. It was found that, over all of this vast territory, changes are characterized by two maximums, spring and autumn, which indicates the existence of a complex natural mechanism of regulation of the methane level in the atmosphere.

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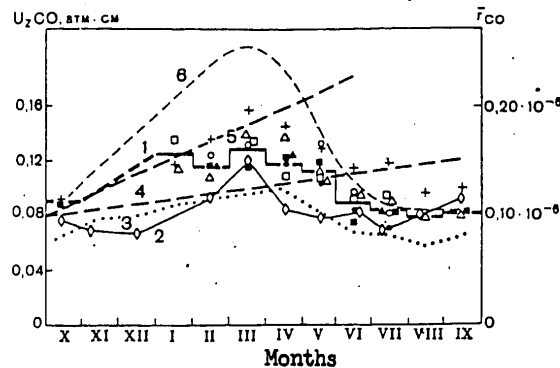


Figure 5. Seasonal course of carbon monoxide level \bar{r}_{CO} - mean ratio of the mixture; 1 - average monthly values, obtained at Zvenigorod Scientific Station in 1970-1976 (\circ , \square , \bullet , $+$, Δ , \blacksquare , \blacktriangle , respectively); 2 - spectroscopic measurements of J. Shaw (USA) in Columbus in 1952; 3 - local chemical measurements by V. Zaylor (West Germany) on Mauna-Loa Island in 1975; 4, 5 - annual accumulation of anthropogenic emissions of carbon monoxide (4 - 1952, 5 - 1971); c - prediction of the seasonal course of U_2 for 2000 A.D.

With methane as an example, it is easy to show specific differences between the integral method of determination of the total level and the local level of the admixture. Measurements of the concentration by volume of methane, conducted by the Institute of Physics of the Atmosphere, with the help of a local laser method (aboard an airplane), gave a great diversity of results even during measurements over one and the same point at short intervals of time. The vertical profiles of methane concentration obtained appeared to be highly variable, reflecting variations of rates of its chemical conversions in different seasons of the year and also peculiarities of the place of conducting the studies. On the basis of this kind of data it would be extremely difficult to show regular seasonal changes of the total methane content in the entire stratum of the atmosphere over great spaces.

We shall now consider the distribution of carbon monoxide, methane and nitrous oxide throughout the earth.

During the cruises of scientific research ships in the Antarctic and conversely by research associates of the Institute of Physics of the Atmosphere and of the Arctic and Antarctic Scientific Research Institute,

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data were obtained concerning the background level of these gaseous admixtures over the Antarctic Ocean and the Indian Ocean (Figure 6). Regular reduction (3-4 times) of carbon monoxide levels were found in the southern hemisphere. This may be associated with the fact that anthropogenic emissions are greater in the northern hemisphere than in the southern hemisphere, in view of the fact that the continents are situated basically in the northern hemisphere. At present, it is still difficult to say if this high background in the northern hemisphere is the result of anthropogenic interference or is a natural ratio determined by the dry land.

We emphasize that the discrepancy of curves (shown in Figure 6), referring to cruises conducted in different seasons of the year, reflects seasonal variations of the carbon monoxide level in the northern hemisphere. This is confirmed by data about the mean values of carbon monoxide levels in the corresponding months over Zvenigorod Scientific Station in 1970-1976 and over Mauna-Loa in 1975.

Figure 6 also presents results of local chemical analysis, conducted by V. Zaylor (Western Germany). He obtained a wide distribution of concentration (ratio of the mixture) \bar{r}_{CO} , averaged for the entire stratum of the atmosphere and the wide distribution of this concentration in the upper troposphere. Comparison of these results with those obtained by us shows that the accuracy of measurements by the spectral method matches the accuracy obtained by good chemical methods which are much more laborious and demanding in respect to conditions for performing the experiment.

During the cruises, there were also obtained data about the latitudinal distribution of methane, which is the initial substance for the photochemical generation of carbon monoxide in the atmosphere, and nitrous oxide. It appeared that the methane level in the atmosphere varies with a change of latitude much less than is the case of carbon monoxide and these variations are comparable to errors of measurements. This justifies the conclusion that the methane background level is approximately uniform throughout the earth. There was confirmed, analogously, the uniform distribution of nitrous oxide in both hemispheres which agrees with modern ideas concerning the significant (several years) lifetime of this admixture in the atmosphere. The uniformity of distribution of methane, evidently, is connected, to a large extent, with the rather uniform distribution of sources of it throughout the world, since the lifetime of this gas in the atmosphere of the planet (months) is much less than the characteristic time of exchange of air masses between hemispheres (2-3 years).

Information concerning variations of them in time has great importance for the study of mechanisms of generation and drainage of admixtures. Spectroscopic measurements of the seasonal course of the levels of carbon monoxide, nitrous oxide and methane over the Antarctic continent (Figure 7) were conducted to obtain such data. As these measurements showed, the carbon

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monoxide level has a minimum in the period of the Antarctic summer which agrees closely with data of studies of the seasonal course in the northern hemisphere. On the basis of the totality of results for the northern hemisphere and the southern hemisphere, it appeared to be possible, for the first time, to construct a preliminary model of the space-time distribution of the background level of carbon monoxide, considering both its seasonal variations and the non-uniformity of distribution throughout the world.

Figure 7 shows that the nitrous oxide level and methane level in the atmosphere over the Antarctic displays practically no variations in time beyond the limits of error of the experiment. While this conforms to expectations for nitrous oxide (the lifetime of this admixture is great) the absence of signs of a seasonal course is unexpected for methane in connection with the seasonal variations of it observed in the northern hemisphere. Such results of measurements indicate the necessity for conducting further studies of the space-time distribution of this gaseous component of the atmosphere.

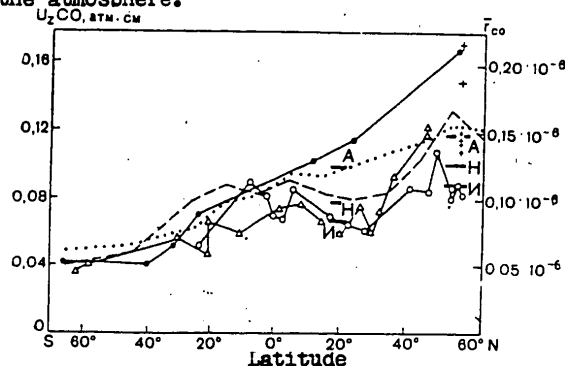


Figure 6. Dependence of background level of carbon monoxide on geophysical latitude.

Continuous broken lines \bullet, Δ, \square are data of spectral measurements from ships in different seasons of the year (April 1976, November 1977, June 1978, respectively): broken lines and dotted solid lines are average data from V. Zaylor (Western Germany), obtained by a local chemical method; bold line segments are average monthly values (A-April, N-November, I-June) for Zvenigorod Scientific Center (55° north latitude), averaged for 1970-1976 and data of V. Zaylor for Mauna-Loa (19.1° north latitude) for 1975.

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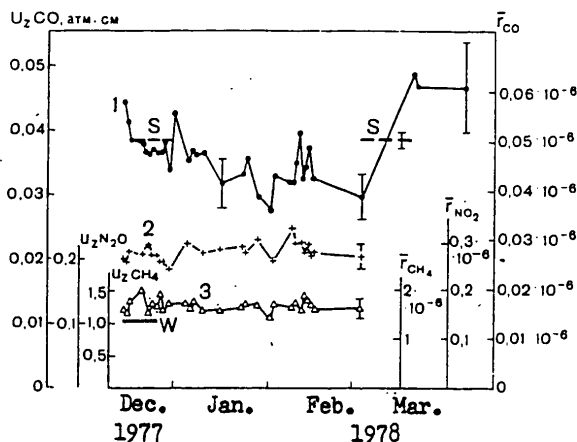


Figure 7. Results of seasonal spectroscopic measurements in Antarctica of the carbon monoxide level (1) nitrous oxide level (2) and methane level (3).

Bold line segments show episodic local measurements of V. Zaylor (Western Germany) S and P. Uilknisa (USA)-W

The studies about which we spoke here represent, in essence, the first extensive and sequential use of the spectroscopic integral method for the study of space-time variations of the gaseous composition of the entire stratum of the earth's atmosphere on a global scale. This method, as investigations showed, is extremely effective for obtaining information concerning the average content of gaseous admixtures in extensive air basins. Therefore, it is promising both for the study of pollutions of air basins over towns as a whole and for determination of the background level of polluting admixtures in the atmosphere within the framework of global monitoring. In the latter case, the use of the spectroscopic integral method in comparison with local methods greatly reduces the requirements for selection of a location of observation points, since local low-power sources of pollution have practically no effect on the representativeness of individual measurements.

At the Conference of the Presidium of the USSR Academy of Sciences, where this scientific conference convened, V.I. Dianov-Klovov was asked several questions. In particular, Academician S.N. Vernov was interested in the possibilities of conducting such research from sputniks. V.I. Dianov-Klovov said that such measurements are now being performed but it is necessary to conduct many terrestrial experiments involving the region over which the sputnik is operating in order to be certain of the identity of results obtained by the different methods and to evaluate the actual accuracy of measurements from space. Extremely promising for these operations, he added, is laser pounding, although the results of such studies should also be studied further.

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In an address to the Conference, Academician G.I. Marchuk emphasized that the reports presented at the Conference represent a significant contribution to the development of monitoring. There are, in the study of background levels of gaseous admixtures in the atmosphere, still many unsolved problems, but the line of research and the means employed are appropriate. He noted that laser methods are now being involved considerably in studies in this area. In particular, scientists of the USSR Academy of Sciences (Siberian Section) Institute of Optics of the Atmosphere and Bulgarian specialists are studying, in a joint program, with the help of laser methods, atmospheric pollution over Sofia and Tomsk. The studies presented at the Conference deserve continued support said G.I. Marchuk in conclusion.

Academician A.M. Obukhov, in his address to the Conference, called attention to the necessity for combining the integral method, discussed at the Conference, with local methods of determination of the level of admixtures in the atmosphere. He noted that the combination of integral and local data is still somewhat of a scientific and technical problem and here the assistance of the hydrometeorological service is desirable.

Summing up the discussions, USSR Academy of Sciences President Academician A.P. Aleksandrov said that global probing of the atmosphere for the purpose of determining gaseous admixtures in it is a most important trend of research. It is necessary to involve the hydrometeorological service in it and to compile a joint plan of research. While approving the studies of the Institute of Physics presented, the President proposed the amplification of them.

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